

İstanbul Kültür University
Faculty of Engineering and Architecture
ENG 007 Engineering Economics

Question 1 (20 points)

Two products are produced in the same line. 70% of total sales belong to product A, and its selling price is \$7500 /unit. Total cost records for 6 months are given below:

Month	1	2	3	4
Production	100	150	200	110
Cost (\$1000)	550	800	950	485

10 pts a) If product B is sold for \$2000 /unit, what is the monthly breakeven point?

Using least squares normal equations we determine the following parameters:

$b = \text{unit variable cost} = \$4600 / \text{unit}$

$a = \text{fixed cost} = \$53,800$

$$p = 0.7 \times p_A + 0.3 \times p_B = 0.7 \times 7500 + 0.3 \times 2000 = \$5850 / \text{unit}$$

$$Q_{BE} = 53,800 / (5850 - 4600) = 43.04 \approx 44 \text{ units}$$

10 pts b) If you want to make \$500,000 monthly profit at monthly sales = 200 units, what would the selling price of product B be?

$$500,000 = (7500 \times 0.7 + p_B \times 0.3) \times 200 - (53,800 + 4600 \times 200)$$

$$p_B = (500,000 + 53,800 + 4600 \times 200 - 7500 \times 0.7 \times 200) / (0.3 \times 200)$$

$$p_B = \$7064 / \text{unit}$$

Question 2 (12 points)

A company produces and sells a consumer product and is able to control demand for the product by varying the selling price. The approximate relationship between price and demand is;

$$p = \$38 + \frac{2700}{Q} - \frac{5000}{Q^2}, \text{ for } Q > 1, \text{ where } p = \text{price per unit, and } Q = \text{demand per month}$$

The fixed cost is \$1000 per month and the variable cost (v) is \$40 per unit.

10 pts a) What is the number of units that should be produced and sold each month to maximize profit?

$$TR = p \times Q = 38Q + 2700 - 5000 / Q$$

$$TC = 1000 + 40Q$$

$$\text{Profit} = TR - TC = -2Q - 5000/Q + 1700$$

$$d(\text{Profit}) / dQ = 0 \Rightarrow -2 + 5000 / Q^2 = 0$$

$$2Q^2 = 5000 \Rightarrow Q = 50 \text{ units}$$

2 pts b) Show that your answer to part (a) maximizes profit.

$$d^2(\text{Profit}) / dQ^2 = -10,000Q / Q^4 < 0 \text{ proves that it refers to a maximum}$$

Question 3 (20 points)

Show whether the flowing statements are TRUE or FALSE, each is 5 points:

a) A certain loan involves monthly repayments of \$185 over a 24- month period. If $\underline{r} = \underline{12\%}$ per year, more than half of the principal is still owed on this loan after the tenth monthly payment is made.

$$P(F/P, \underline{12\%}, 10) - P(A/P, \underline{12\%}, 24) (F/A, \underline{12\%}, 10) > 0.5P$$

$$(F/P, \underline{12\%}, 10) - (A/P, \underline{12\%}, 24) (F/A, \underline{12\%}, 10) > 0.5$$

$$(F/P, \underline{12\%}, 10) - (A/P, \underline{12\%}, 24) (F/A, \underline{12\%}, 10) = 0.8620, \text{ so TRUE}$$

b) \$1,791 ten years from now is equivalent to \$900 now if the interest rate equal 8% compounded annually.

$$900 (F/P, 8\%, 10) = 1943 > 1791 \text{ so FALSE}$$

c) An investment of \$6,000 yields a return of \$1,500 at the end of each of the next four years. The internal rate of return on this investment is zero percent.

$$6000 - 1500 \times (P/A, i\%, 4) = 0 \Rightarrow (P/A, i\%, 4) = 4, \text{ is possible only when } i=0 \text{ TRUE}$$

d) For a specified value of F at EOY N, P at time zero will be larger for $\underline{r} = \underline{10\%}$ per year than it will be for $r = 10\%$ per year, compounded monthly.

$$i_{\text{eff}} = (1 + 0.1 / 12)^{12} - 1 = 10.5\%$$

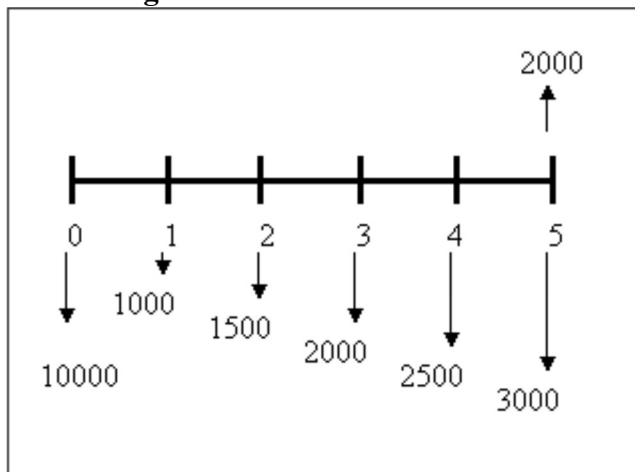
$$F (P/F, \underline{10\%}, N) < F (P/F, 10.5\%, N) \text{ so FALSE}$$

Question 4 (15 points)

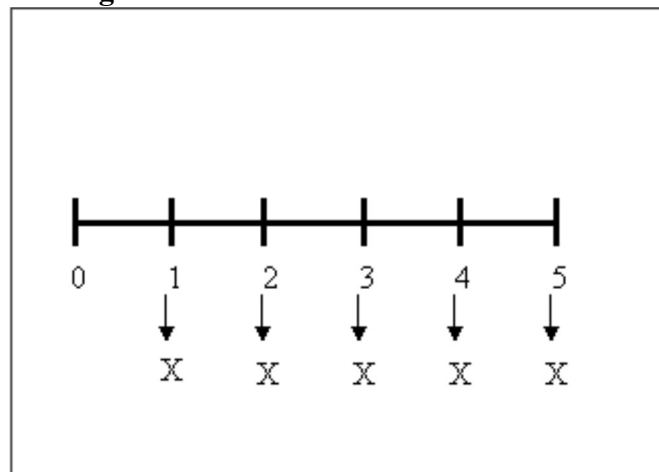
A company is considering investing \$10,000 in a heat exchanger. The heat exchanger will last 5 years, at which time it will be sold for \$2,000. The maintenance cost at the end of the first year is estimated to be \$1,000. Maintenance costs for the exchanger are estimated to increase by \$500 per year over its life. As an alternative, the company may lease the equipment for \$X per year, including maintenance.

5 pts a) Draw a cash flow diagram of both alternatives.

Purchasing:



Leasing:



10 pts (b) For what value of X should the company lease the heat exchanger?
The company expects to earn 8% on its investments. Assume end-of-year lease payments.

$$AW(\text{leasing}) < AW(\text{purchasing})$$

$$X < 10000(A/P, 8\%, 5) + 1000 + 500 (P/G, 8\%, 5) - 2000 (P/F, 8\%, 5)$$

$$X < \$4,087$$

Question 5 (13 points)

Consider the cash flows presented in the accompanying table, and find the AW(10%) of this project:

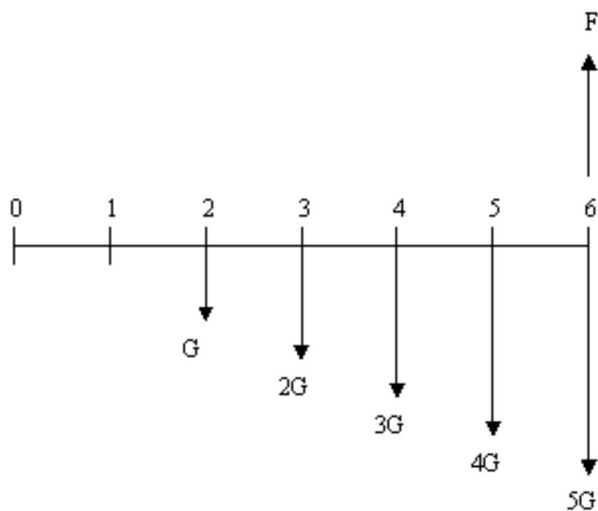
End of Year	Net cash flow
0	- 450,000
1	- 42,500
2	+ 92,800
3	+ 386,000
4	+ 614,600
5	- 202,200

$$AW = (A/P, 10\%, 5) \times [-450,000 - 42,500(P/F, 10\%, 1) + 92,800(P/F, 10\%, 2) + 386,000(P/F, 10\%, 3) + 614,600(P/F, 10\%, 4) - 202,200(P/F, 10\%, 5)]$$

$$AW = + \$ 45,385$$

Question 6 (20 points)

Refer to accompanying cash flow diagram, and solve the following parts.



10 pts a) If $F = \$10,000$, what value of G makes $IRR = 15\%$?

$$PW(15\%) = 0 = 10,000 (P/F, 15\%, 6) - G (P/G, 15\%, 6)$$

$$G = \$587$$

10 pts b) If $F = 25G$ and $e = 10\%$, what is the ERR?

$$PW(\text{cost}) = G (P/G, 10\%, 5)$$

$$FW(\text{revenue}) = 25G - 5G = 20G$$

$$ERR = [20G / G(P/G, 10\%, 5)]^{1/6} - 1 = 18\%$$

